Techniques for Future Decision-making in Range, Wildlife, and Fisheries Management

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Commercial and recreational demands for wildlife, fish, and range resources have increased significantly during recent years, and the upward trends are expected to continue. For example, approximately 18 million fur pelts were harvested in the 1979–80 trapping season, 2.6 times that harvested in 1971. Annual salmon harvests reached over 600 million pounds in the late 1970's and early 1980's, considerably above the 200 to 400 million pounds common in the preceding 25 years. The number of hunting and fishing licenses purchased has increased almost 50 percent in the last 20 years. Similarly, the demand for forage on public rangelands has increased about 15 percent since 1980. The legal mandates to protect wild horses and burros and conserve threatened and endangered plants also intensified the demand for rangeland resources, as did the growing concern for an adequate supply of quality water, clean air, and open space.

Loss of Forests and Rangelands

The intensified use of forests and rangelands for production of other goods and services such as urban development, transportation systems, and extraction of minerals and fossil fuels is having a significant impact on our wildlife and fish habitat and range resources.

The Environmental Protection Agency estimates that as much as 2 million acres of wildlife and fish habitat will be lost annually between now and the year 2,000. Nearly half of the wetlands that once existed in the continental United States are gone, and quality of many of the remaining areas has been seriously compromised.

More than half of the rangeland in the lower 48 States is in unsatisfactory condition and producing less than 40 percent of its natural, potential forage, wildlife habitat, and water. Intensive timber production, which harvests stands at younger ages, reduces plant species diversity and diminishes habitat for wildlife dependent on older, less vigorous forest communities. Approximately 180 vertebrate species in the United States are listed as actually or potentially in danger of extinction, as are nearly 80 species of terrestrial plants.

These numbers may increase drastically unless specific management strategies are implemented to successfully interweave wildlife, range, and fish goals with other land-use objectives.

Multiple-use Management

In the face of increasing demands for all forest and rangeland products, including timber, fiber, energy, wildlife, grazing, fisheries, water, and recreation, and a decreasing land base for the production of these natural resources, managers can no longer afford the *laissez faire*, single-resource approach to management that was typical in the past. Planning and management for any single resource must include consideration and adjustment for associated resources. This managerial strategy was made binding by a series of recent laws aimed at resource integration: National Environmental Policy Act of 1969, Wild Horses and Burros Protection Act of 1971, Endangered Species Act of 1973, Forest and Rangelands Renewable Resources Planning Act of 1974, National Forest Management Act of 1976, Federal Land Policy and Management Act of 1976, Public Rangelands Improvement Act of 1978, and Fish and Wildlife Conservation Act of 1980. As a result, managers are now in an era of coordinated, intensive forest and rangeland management in which interdisciplinary planning is an important element, if not a legal mandate.

Multiple-use is not a new theory, nor is it a difficult concept to grasp. Initiating such a program, however, involves addressing a maze of social, political, and biological concerns and alternatives. This decision labyrinth is so complex and continually changing that it almost defies solution. But this challenge must be met.

Research for Better Management

Research conducted by the U.S. Department of Agriculture's Forest Service and State agricultural experiment stations is providing an ever-expanding wealth of new knowledge and management guides on the relationships between differing land uses and probable consequences of alternative management prescriptions. For example, they are collecting information on the influences of various forest and range management strategies on short- and long-term timber and forage production, water yield and quality, sediment yield, wildlife and fish habitat value, and local socioeconomic stability. This and other detailed technical information is being compiled and stored in computer systems, making the information readily accessible to managers. In addition, numerous models or computer-based tools are being developed using these newly quantified relationships that allow resource managers to manipulate this new knowledge base and present it in a comprehensive form for analysis of management alternatives.

These models differ greatly in style and complexity. The more complex simulation models rely on a complete understanding of vegetation growth patterns and responses to management to project future plant communities, successional stages, and habitat conditions. STEMS and its microcomputer counterpart, TWIGS, are forest stand simulation models developed to help small landowners predict what will happen to their forest stand if they harvest trees. FORPLAN (*For*est *Plan* Simulator) is a larger, more complex forest simulation model used to predict results of forest management on entire National Forests. By including wildlife habitat capability models in STEMS or FORPLAN, landowners also can predict influences on wildlife such as squirrels, woodpeckers, deer, and turkey.

Habitat Capability Models.

These models include specific information on the relationships between resources (such as how soil, plants, and animals are affected by the amount and quality of each resource), and measure the ability of a specific forest, rangeland, pond, or stream to support a mixture of renewable resources. Habitat capability models, when driven by accurate and complete technical information databases and combined with simulation models, are powerful tools for natural resource managers. They can quickly examine a wide variety of management alternatives and correctly project the influence of management of each individual renewable resource, including wildlife and fish species, over a broad spectrum of forest and rangeland ecosystems. In addition, tables and graphs produced by these models allow resource managers to more clearly document and describe recommendations and anticipated resource responses to colleagues, superiors, and the public.

Research Challenges. Long-term forecasting of resource outputs using these tools assumes that plant community simulations and animal-to-habitat relationships are fully understood and accurate enough to let managers reach reasonable conclusions about the multiple-resource productivity of forest and rangeland conditions.

The underlying basic ecological relationships, however, have not been fully tested in some community types and successional stages. An eminently imposing research challenge is to develop a comprehensive understanding of how plant growth is regulated and how it responds to environmental extremes. Also, little is known about the specific habitat requirements of many rare or particularly secretive wildlife and fish species.

These gaps in our information data base pose the challenge research must meet in the next decade. Existing models must be tested and refined, and new models developed where none exist. Inherent in this objective is continued examination of water, soil, plant, and animal relationships in forest and rangeland ecosystems.

Forest Service scientists are investigating new methods for efficiently and accurately monitoring wildlife and plant communities to provide the tools to test and refine our models and management practices. Other scientists are testing, refining, and retesting habitat models for anadromous fish, song birds, and endangered species by studying in ever greater detail where these animals live, feed, and reproduce.

The computer models of tomorrow will then produce results that are consistent and accurate enough to serve as valid tools for the display of multiple-resource tradeoffs. In their current state of development, these computer tools provide only general management direction. Management of the forests and rangelands of tomorrow, however, will require the use of more sophisticated models containing increasingly detailed data and ca-

Computer models help resource managers estimate future conditions of plant communities and wildlife habitats like this native grassland in Montana.

pable of more critical analyses of management alternatives.

Challenges to Managers

More sophisticated models do not mean that the range manager or the wildlife or fisheries biologist of the future will simply be a mechanic punching keys at a computer terminal. On the contrary, the life of the professional natural-resource manager will be more exciting and challenging because of the vastly superior information base to work with and the tools to use that information properly. Data bases, habitat capability models, and simulation models will supplement the resource manager's knowledge, not replace it.

There will still be hard choices to make. Natural resource managers will still face a dilemma: how to arrive at the best decision when many of the socioeconomic variables, so important in the decisionmaking process, remain intangible. They can't have more of everything. Compromise will remain a must. Effective integrated management requires decisions which implement Federal and State laws and balance resource outputs with public needs and desires.

Resource management will not be integrated without soul searching, conflict, and goal setting. Data bases and models will vastly help with sorting information, identifying alternatives, evaluating consequences of those alternatives, forecasting, and so forth. But they are only tools; they alone will not integrate the management process. Professional, trained resource managers are still the operative element. Only through a concerted effort by the trained manager will all resources be integrated and true multiple-use management be realized. Through research today, the resource manager of forests and rangelands of the future will have the tools to breach the maze.

Forest Land-Management Decisions

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One-third of our Nation's total land area is covered by forests, and nearly two-thirds of this forest is capable of growing continuous crops of trees and other forest products. The full benefits from this renewable resource, however, cannot be realized without proper forest management supported by a dynamic research program. Management programs are often judged to be good or bad based on how they affect development of a forest and whether this forest provides the mix of goods and services required by our society.

Forest land managers have long wished for a view of the future forest that reflects the consequences of their management decisions. Today, the application of computer technology to the quantitative analysis of the forest resource gives the land manager that look into the future. Future advances in mathematical modeling and our understanding of the biological aspects of the forest will increase the precision and reliability of this forecasting.

Computer Models

To a large measure, forest land management has historically been based on our ability to estimate changes in tree growth and volume yield (productivity) in response to specific silvicultural treatments. In the last two decades, research has developed growth and yield prediction methodology using new computer technology